

Measurements of the High Pressure Ultrasonic Wave and the Cavitation Bubble by the Optodynamic Method

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Laser induced breakdown in water is an abrupt high intensity photoacoustic phenomenon. The pressure front that appears at its site represents an ultrasonic shock wave spreading into surrounding water. At the same time the cavitation bubble develops. The effect of both is particularly important in ocular microsurgery, where Q-switched lasers are used to vaporize the tissue in procedures such as posterior capsulotomy. Formation of the cavitation bubble and the propagation of the sound wave were analyzed by an optodynamic experimental setup. This setup is based on a two dimensional scanning technique using a beam deflection probe. The times of flight for the sound wave and the cavitation bubble were determined using the beam deflection probe. The two-dimensional time of flight data field was used to determine the sound velocity of the shock wave. There were two regions of propagation of acoustic waves in water: close to the breakdown site a supersonic velocity region was found which gradually turns into a sonic velocity region. By using the equation of state of water, the pressure amplitude in the shock waves was also estimated. Simultaneously the expansion of the cavitation bubble was also analyzed. The velocity of the bubble walls and its energy were determined from the measured data.